LONGITUDINAL STUDY OF GAIT STABILITY AFTER CONCUSSION

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INTRODUCTION

The need to identify functional impairment following a brain injury is critical to prevent re-injury during the period of recovery. Research to date has focused on neuropsychological tests and static postural control during quiet standing. Little is known about the effect of concussion on dynamic motor function [1,2,3]. A recent study suggested that the ability to control and maintain stability in the frontal plane during walking is diminished in young individuals following a concussion while walking under a divided attention [4]. However, this study did not resolve the issue of how long this pattern continues. Therefore, the purpose of this study was to perform a longitudinal quantification of deficits in maintenance of dynamic stability during gait of individuals following concussion.

METHODS

Fifteen college-age subjects with Grade 2 concussions (CONC) and 15 uninjured controls (NORM) were observed while walking under two conditions: 1) undivided attention (single-task) and 2) while simultaneously completing simple mental tasks (dual-task). Testing began within 48 hours of injury (day 2) and repeated at 5, 14, and 28 days post injury. NORMs were evaluated at the same intervals.

Whole-body motion data were collected using a six-camera motion analysis system and two force plates. A 13-link biomechanical model was utilized to compute whole body center of mass (COM). Center of pressure (COP) was computed with ground reaction forces. In addition to temporal distance gait parameters, anterior and medial-lateral COM motion (APROM, MLROM), peak anterior velocity of the COM (ANTVEL), and the maximum separation between the COM and COP (APMAX) were used to examine dynamic stability. Three-way repeated-measures mixed design ANOVA and Tukey *post hoc* tests were completed to determine differences between group, task, and testing day.

RESULTS AND DISCUSSION

Group by day as well as task by day interactions were found for gait velocity and stride length. Gait velocity was significantly decreased for the CONCs on the dual-task compared to single-task for all days while NORMs were only significantly decreased on the dual-task for days 2 and 5. The CONCs' stride length was significantly decreased compared to the NORMs on both tasks on days 2 and 14. In addition, the stride length on the dual-task was significantly smaller than the single-task for the CONCs on days 2 and 5. Significant group by day interactions were found for MLROM and APMAX. A significant task by day interaction was found for APROM and ANTVEL. Follow-up analyses revealed medial-lateral COM sway was significantly increased for days 2, 5, and 28 for CONCs compared to NORMs on the dual-task

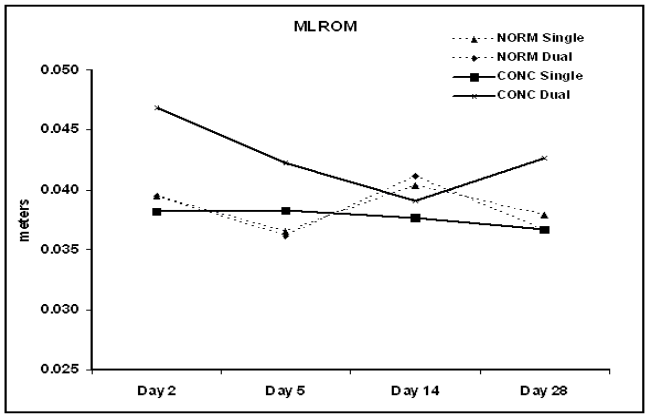

Figure 1: Medial-lateral range of motion of the COM

(Figure 1). One possible explanation may be that when required to divert their attention to a concurrent task, the CONCs could not adequately adjust to the challenge and therefore sway more, compromising their stability. By the last testing the CONCs have returned to play and this increase in activity is likely the cause of the decrease in performance seen on day 28. The CONCs displayed decreased APMAX at days 2, 14, and 28 compared to the NORMs. For CONCs under the dual-task condition, APROM was significantly decreased on days 2 and 5 and ANTVEL was significantly decreased on all 4 days.

CONCLUSIONS

Concussed individuals continue to display significant differences in anterior velocity and COM movement when compared to uninjured controls up to four weeks after injury. The demands of performing a dynamic motor task combined with a mental activity that divides attention may effectively approximate the demands of an athlete in competition. However, if the concussed individuals have difficulty maintaining stability in a controlled environment they may well have difficulty adjusting to the multiple input environment of the athletic arena. The findings of this study demonstrate that concussion has an observable and measurable effect on the body's ability to maintain and control dynamic stability for up to four weeks after injury.

REFERENCES

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